CLAIMS

1. A photonic crystal biosensor comprising:

an array of two-dimensional unit cells, each of said unit cells having a substrate and a multitude of raised portions arranged in a regular repeating pattern wherein said raised portions are separated from each other by adjacent void portions, said raised portions made from a material having a relatively high index of refraction n1 greater than that of water;

wherein each of said unit cells further comprises a defect wherein the regular repeating pattern of said raised portion separated by adjacent voids is modified such that at the defect said material having a relatively high index of refraction n1 occupies the space of one or more of the voids;

wherein a localized maximum of electromagnetic field intensity is produced in the region of said defect in response to incident light on said photonic crystal at a resonant frequency;

and wherein, during use, a fluid containing a sample to be tested is placed on said photonic crystal and contained in said void portions.

2. The photonic crystal biosensor of claim 1, further comprising a structure placed adjacent to said array of unit cells, said structure having a plurality of apertures, each of which overlie a plurality of said unit cells, and wherein said fluid sample introduced into said apertures in said structure is contained in said void portions proximate to the defect in said unit cells.

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3. The photonic crystal biosensor of claim 2, wherein said structure comprises a multi-well device, arranged in an array or rows and columns of wells, which is affixed to said photonic crystal biosensor.

4. The photonic crystal biosensor of claim 1, wherein said multitude of raised portions comprise raised portions in said substrate and a material of index of refraction n1 deposited on said substrate.

5. The photonic crystal biosensor of claim 1, wherein said defects are located substantially at the center of each of said unit cells.

6. The photonic crystal biosensor of claim 1, wherein said material with an index of refraction n1 comprises a layer of between 100 and 140 nm high refractive index material with n1 = 2.25.

7. The photonic crystal biosensor, further comprising a reading instrument illuminating said photonic crystal biosensor and determining a shift in the resonant frequency of the peak wavelength of light reflected from said photonic crystal biosensor.

8. The photonic crystal biosensor of claim 1, wherein the design of the defect is selected by use of a finite difference time domain computer model of said photonic crystal biosensor.

9. The photonic crystal biosensor of claim 1, wherein said array of unit cells comprises an array of unit cells, each comprising a two-dimensional array of raised portions and adjacent void portions forming a checkerboard arrangement.

10. The photonic crystal biosensor of claim 9, wherein the size of the raised portions and the size of the adjacent void portions are substantially equal except in the region of said defect

11. The photonic crystal biosensor of claim 9, wherein the size of the raised portions and the size of the adjacent void portions varies continuously along an axis extending from the perimeter of said unit cell to the defect cavity at the center of the unit cell and to the opposite perimeter of said unit cell.

12. The photonic crystal biosensor of claim 1, wherein each of said unit cells comprises an arrangement of raised portions and adjacent void portions arranged in a hexagon, with the defect located at the center of the hexagon.

13. The photonic crystal biosensor of claim 12, wherein said void portions comprise an arrangement of holes formed in said substrate in a manner such that, in the periphery of said hexagon said holes are of a first size, and in the region of the center of said hexagon the holes are of a size smaller than said first size.

14. The photonic crystal biosensor of claim 13, wherein at the center of said hexagon, there is no hole.

15. A method of testing a sample, comprising the steps of:

1) introducing a fluid sample onto a defect cavity photonic crystal biosensor, said biosensor comprising an array of two-dimensional unit cells, each of said unit cells having a substrate and a multitude of raised portions arranged in a regular repeating pattern wherein said raised portions are separated from each other by adjacent void portions, said raised portions made from a material having a relatively high index of refraction n1 greater than that of water;

wherein each of said unit cells further comprises comprise a defect wherein the regular repeating pattern of said raised portion separated by adjacent voids is modified such that at the defect said material having a relatively high index of refraction n1 occupies the space of one or more of the voids; wherein a localized maximum of electromagnetic field intensity is produced in the region of said defect in response to incident light on said photonic crystal at a resonant frequency;

2) illuminating said photonic crystal biosensor, and

3) determining the frequency of the peak wavelength of light either reflected from or transmitted through said photonic crystal biosensor.

16. The method of claim 15, wherein the photonic crystal biosensor is affixed to a device containing the fluid sample, said device arranged in an array of rows and columns.

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17. The method of claim 15, wherein multitude of raised portions comprise raised portions in said substrate and a material of index of refraction n1 deposited on said substrate.

18. The method of claim 15, wherein said defects are located substantially at the center of each of said unit cells.

19. The method of claim 15, wherein said material with an index of refraction n1 comprises a layer of between 100 and 140 nm high refractive index material with n1 = 2.25.